Y. Chao
May 10, 1989

USER'S GUIDE TO LOMA LINDA EXTRACTION TRACKING PROGRAM

This is a brief guide for those who intend to use the Loma Linda extraction tracking program (abbreviated as **TRAC** in the following) in their own pursuit of truth. I strive to keep the size of this note small so that most of the time on the users' part is spent trying out the program itself and most of the informa-tion is afforded directly through interacting with the program itself.

To begin, it is advised that the user copy all files from the area

USR$DISK3:[CHAO.SCR]

to his own designated subdirectory. A typical run of TRAC generates a myriad of data and graphics files, some to be used as inputs to generate still more files. It is therefore wise to tailor the various batch command files to deposit the output files in the user's scratch area and work on them there. (See for example the files STR.COM and TRAC.COM.)

1. Overview

This program consists of two complementary parts. One is a multi-particle, multi-turn tracking program which mimics the time evolution of a particle distribution in the phase space in the machine. From this we get extraction efficiency and time structure, and (one-to-one or overall) mapping between initial and final distributions. The other one is a single particle tracking program from which we can extract machine parameters such as chromaticity and dispersion, or dynamical quantities such as closed orbit, tune, and tune spread. The combined use of these two parts allows us great flexibility in studying the extraction performance.

The program incorporates all optical elements and dynamical variables relevant to the extraction process into the tracking environment. It includes the effect of individual main magnet multipole contents up to decapole as measured, all trim dipoles and octupole, and the time-varying trim quadrupole ramps. A 3-vector $(x,x',dP/P)$ is assigned to each particle so that with properly chosen dP/P, the effect of the radial offset can also be simulated. The multiparticle distribution can be either tri-Gaussian or a cubic grid. In the latter case the mapping between the initial and the final phase space distributions can be more systematically studied.

In section 2 the structure of the program and the function of each component will be discussed. This is followed by a detailed explanation of all the input and output files in section 3.

2. Structure of the program

Figures 1 and 2 show the function of various programs and the flow of information for the multiparticle and single particle tracking programs respectively. These two programs are discussed in the following.

(a). The multiparticle tracking program (TRAC)

The primitive input data reside completely in the input file **TRACIN.DAT**, which in turn can be generated by the program **CONTR** when it is desired to use tune shift, stopband width, phase shift etc. as alternative input control parameters. The files labeled with an asterisk in figure 1 are input files while the rest are either intermediate or terminal output files. A typical run of the program also generates a number of DI_3000 or PICSURE **QMS.DAT** files, the number of which depends on the detail of the run. A PVI graphics metafile **TRAC.MET** can also be generated at user's discretion in case he wants to extract only a subset of the entire graphics file for viewing.

Apart from the input/output files in figure 1, we have components responsible for execution of desired activities. These go under 2 categories: the .EXE files executed by a "RUN" command and the PICSURE command files executed by a "READ COMMAND" command in the PICSURE environment. The latter is exclusively for generating QMS.DAT graphics files or viewing on a graphics terminal. Both are clearly indicated in figure 1. The files TRAC.EXE, THARD.EXE and COLD.EXE also generate DI_3000 graphics files. It is therefore advised that before running these programs, the user issues a "$SETDRV device index" command according to what graphics media he wants to use.

In the following I will describe the function of each file and their relation to each other. (An asterisk is attached to files responsible for executing programs desired by the user, either an executable file or a PICSURE command file.)

COLD.EXE* Generates the (color or normal laser) graphics file which shows the phase space distribution of all particles at the septum and lambertson respectively. 3 sets of data are shown in each plot representing the last 3 turns prior to exiting the machine of every particle. See LCG01.DAT for detail.

CONTR.DAT Input file for CONTR.EXE specifying the ramping condition in terms of tune shift, stopband width, phase shift and octupole strength.

CONTR.EXE* Generates the input file TRACIN.DAT for TRAC.EXE according to the specification of CONTR.DAT

CUMUL.DAT Intermediate file used by STOP.COM for generating graphics file to show cumulative extracted particles vs time.

DCU.DAT Intermediate file used by STOP1.COM for generating graphics file to show extracted particles vs time. This has to be generated by DIFF.EXE.

DIEXT.COM* Generates graphics file QMS.DAT showing the distribution of extracted particles in the spaces spanned by X-X', dP-X and dP-X' respectively.

DIFF.EXE* Converts the format of "cumulative extracted or lost particles vs time" in files CUMUL.DAT and LOSS.DAT into that of "extracted or lost particles vs time" in the files DCU.DAT and DLO.DAT

DILO3.COM Generates graphics file QMS.DAT showing the distribution of particles lost at septum in the spaces spanned by X-X', dP-X and dP-X' respectively.

DILO4.COM Generates graphics file QMS.DAT showing the distribution of particles lost at lambertson in the spaces spanned by X-X', dP-X and dP-X' respectively.

DIREM.COM Generates graphics file QMS.DAT showing the distribution of remaining particles in the spaces spanned by X-X', dP-X and dP-X' respectively.

DISTR.COM Generates graphics file QMS.DAT showing the distribution of extracted particles which bypassed the septum in the spaces spanned by X-X', dP-X and dP-X' respectively.

DLO.DAT Intermediate file used by STOP1.COM for generating graphics file to show lost particles vs time. This has to be generated by DIFF.EXE.

EGRID.DAT Data file showing relevant information about all extracted particles.

EXT1.DAT Data file of extracted particles to be used by TIS2.EXE for eventually generating phase space distribution plots.

HARDLIS.DAT Prescription file telling THARD.EXE which plots to extract from the graphics metafile TRAC.MET.

IGRID.DAT Data file showing initial condition of all particles.

LCG01.DAT Color graphics file showing 3 turns prior to exit of all particles, at both L3 and L4. The marker code is as follows:

        circle: 2 turns before exit
        cross : 1 turn before exit
        star   : exiting turn
        The color code is as follows:
        red   : extracted at lambertson without going through septum
        yellow: lost at septum
        blue   : lost at lambertson
        green : extracted at lambertson by way of the septum

Note: With various combinations of switches selected in TRACIN.DAT, some of the above colors are automatically suppressed. The user should keep in mind his input condition when looking at the plots.

LGRID.DAT Data file showing relevant information about all lost particles.

LOSS.DAT Intermediate file used by STOP.COM for generating graphics file to show cumulative lost particles vs time.

LOS3.DAT Data file of particles lost at septum to be used by TIS2.EXE for eventually generating phase space distribution plots.

LOS4.DAT Data file of particles lost at lambertson to be used by TIS2.EXE for eventually generating phase space distribution plots.

L3.DAT Intermediate file with phase space information of all particles at L3 grouped by the way they exit. This is used by COLD.EXE to generate color graphics.

L4.DAT Intermediate file with phase space information of all particles at L4 grouped by the way they exit. This is used by COLD.EXE to generate color graphics.

PEX.DAT Intermediate file generated by TIS2.EXE to be used for phase space distribution plots.

PL3.DAT Intermediate file generated by TIS2.EXE to be used for phase space distribution plots.

PL4.DAT Intermediate file generated by TIS2.EXE to be used for phase space distribution plots.

PRE.DAT Intermediate file generated by TIS2.EXE to be used for phase space distribution plots.

PST.DAT Intermediate file generated by TIS2.EXE to be used for phase space distribution plots.

QMS.DAT Terminal graphics output generated by various PICSURE command files or executable image files using DI_3000. It is assumed that the user is familiar with this file.

Q1.DAT Intermediate file providing information of quad #1 strength vs time for STOP.COM and STOP1.COM.

Q2.DAT Intermediate file providing information of quad #2 strength vs time for STOP.COM and STOP1.COM.

Q3.DAT Intermediate file providing information of quad #3 strength vs time for STOP.COM and STOP1.COM.

Q4.DAT Intermediate file providing information of quad #4 strength vs time for STOP.COM and STOP1.COM.

RECORD.DAT Terminal record file for a run of TRAC showing optical and dynamic information at the beginning and at user specified turns. It also gives the content of each plot in the graphics file TRAC.MET

REM1.DAT Data file of remaining particles to be used by TIS2.EXE for eventually generating phase space distribution plots.

RGRID.DAT Data file showing relevant information about all remaining particles.

SEX.DAT Intermediate file generated by TIS2.EXE to be used for phase space distribution plots.

SGRID.DAT Data file showing relevant information about all extracted particles bypassing the septum.

SL3.DAT Intermediate file generated by TIS2.EXE to be used for phase space distribution plots.

SL4.DAT Intermediate file generated by TIS2.EXE to be used for phase space distribution plots.

SRE.DAT Intermediate file generated by TIS2.EXE to be used for phase space distribution plots.

SST.DAT Intermediate file generated by TIS2.EXE to be used for phase space distribution plots.

STOP.COM* Generates plots showing cumulative extracted and lost particles vs time and all 4 quad ramps as functions of time.

STOP1.COM* Generates plots showing extracted and lost particles vs time and all 4 quad ramps as functions of time.

STR1.DAT Data file of extracted particles bypassing the septum to be used by TIS2.EXE for eventually generating phase space distribution plots.

THARD.EXE* Acts on the metafile TRAC.MET to extract only the user selected plots from a run.

TISLIS.DAT Prescription file for TIS2.EXE specifying input and output files and formats. The user is advised not to touch this unless he knows what he is doing.

TISOUT.DAT Output from TIS2.EXE briefly summarizing the particle count for various exiting conditions.

TIS2.EXE* Generates files XST.DAT..... etc to generate in turn the phase space distribution of particles satisfying specific exiting conditions. This can be used effectively only if the user selects a 3-dimensional cubic distribution in the input file TRACIN.DAT.

TRAC.EXE The master program for tracking.

TRAC.MET Metafile generated along with a TRAC run (if so selected by the user in TRACIN.DAT). See THARD.EXE

TRACIN.DAT Master input file for TRAC.EXE. See next section for detail.

TRACIN.MOD Input file used in conjunction with CONTR.DAT by CONTR.EXE to create TRACIN.DAT. This file provides part of the information the user wants to insert in TRACIN.DAT which is not provided by CONTR.DAT.

XEX.DAT Intermediate file generated by TIS2.EXE to be used for phase space distribution plots.

XL3.DAT Intermediate file generated by TIS2.EXE to be used for phase space distribution plots.

XL4.DAT Intermediate file generated by TIS2.EXE to be used for phase space distribution plots.

XRE.DAT Intermediate file generated by TIS2.EXE to be used for phase space distribution plots.

XST.DAT Intermediate file generated by TIS2.EXE to be used for phase space distribution plots.

(b). The single particle tracking program (TRAS)

Figure 2 shows the components of the single particle tracking program TRAS.EXE. It spins off much less files than TRAC. These files are used mainly for extracting information on optical and dynamic quantities such as closed orbit, tune, dispersion, chromaticity etc. They are also very helpful in revealing the phase space structure at various locations. In the following description of the files are given.

AVEP.EXE* Calculates the mean and RMS of the X'-values stored in the files TBT.DAT, TBT3.DAT or TBT4.DAT. This program can be used iteratively in conjunction with the program GEH1.EXE to determine the closed orbit (X,X') values at L1 as input initial coordinates in TRACIN.DAT or TRASIN.DAT to minimize betatron oscillations due to mismatch into the ellipse.

CONTR.DAT Input file for CONTR.EXE specifying the ramping condition in terms of tune shift, stopband width, phase shift and octupole strength.

CONTR.EXE* Generates the input file TRASIN.DAT for TRAS.EXE according to the specification of CONTR.DAT

GEH1.EXE* Calculates the mean and RMS of the X-values stored in the files TBTF.DAT,TBTF3.DAT or TBTF4.DAT. It also fast Fourier transforms the data given in these files and lists the first 10 peaks in the spectrum.

RECORD.DAT Same as in (a)

QMS.DAT Same as in (a)

TBT.COM* PICSURE command file for generating phase space turn by turn plot at L1.

TBT.DAT Output file of TRAS.EXE giving the (X,X') pairs for the number of turns specified at L1.

TBTF.DAT Output file of TRAS.EXE giving the X-value for the number of turns specified at L1.

TBT3.COM* PICSURE command file for generating phase space turn by turn plot at L3

TBT3.DAT Output file of TRAS.EXE giving the (X,X') pairs for the number of turns specified at L3.

TBTF3.DAT Output file of TRAS.EXE giving the X-value for the number of turns specified at L3.

TBT4.COM* PICSURE command file for generating phase space turn by turn plot at L4.

TBT4.DAT Output file of TRAS.EXE giving the (X,X') pairs for the number of turns specified at L4.

TBTF4.DAT Output file of TRAS.EXE giving the X-value for the number of turns specified at L4.

TRAS.EXE* The master single particle tracking program

TRASIN.DAT The master input file for TRAS.EXE